A SYSTEM OF NON CONTACT MICROTROPOGRAPHY

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INTRODUCTION

As consumers exigence and competition grows the industrial companies requires more reliable, accurate and versatile surface inspection systems to be developed. Fabrics thickness measurements where usually made by means of contact probes that deformed the samples leading to the necessity of complicated correction procedures. We have developed an optical system of non contact microtopography based on a simple principle of triangulation, devoted to measure thickness and relief mapping of fabrics.

PRINCIPLES

If we have a plane horizontal surface illuminated obliquely with light beam and we move it vertically, the bright spot on the surface, viewed vertically, will be displaced. The relation between this horizontal shift of the bright spot and the vertical displacement of the surface is shown in Fig. 1. To make the topographic inspection we must obtain for each point of the surface a certain height value and to do so we can sweep the surface point per point with an oblique light beam focused onto the surface producing the smallest possible bright spot on it. Bright's spot position will be registered at each sampled point and the height values will be then easily computed.

EXPERIMENTAL SETUP

The created system [1,2,3] is formed by an illuminating setup which will produce a small bright spot on the surface and consists on an HeNe laser (TEM00, 632.8 nm, 1mw) mounted on a structure that allows changes in the incidence angle, and an incidence optical system formed by a filter and a convergent lens. The sample is placed on a reference surface endowed of X,Y,Z and rotational, on the horizontal plane, motion. The bright spot position is traced by means of a microscope objective tied to a video camera controlled by an automatic data handling system, driven through a microcomputer. It also controls the sample positioning. All parts of the optical system can be changed depending on the characteristics of the surface to analyze.

Review of Progress in Quantitative Nondestructive Evaluation, Vol. 10B
Edited by D.O. Thompson and D.E. Chimenti, Plenum Press, New York, 1991

EXPERIMENTAL RESULTS

The system has been used to make thickness and roughness measures and microtopographic inspection of several kinds of sample: fabrics, machined surfaces, polyethylene films, plastic moulds, metallic thin films,...[2,3]. We are showing now (Table 1) a table of thickness measures of eight fabric samples with different compressibility, made with our system and a contact gauge.

$Y/X = \tan \alpha$

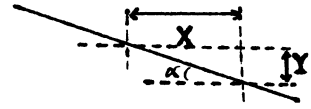

Fig. 1. The basic idea.

Table 1.

FABRICS

	SAMPLE LISTED BY INCREASING COMPRESSIBILITY							
THICKNESS	1	2	3	4	5 LADDER	6 LADDER	7 LADDER	8 LADDER
OUR MEASURE μm (r.m.s.)	296 +/- 4	339 +/- 4	466 +/- 4	649 +/- 4	875 +/- 7	1296 +/- 7	1856 +/- 10	2199 +/- 10
DIFFERENCE	+ 16	+94	+187	+279	+301	+407	+631	+757
CONTACT GAUGE μm (r.m.s.)	280 +/- 15	245 +/- 10	279 +/- 10	370 +/- 15	574 +/- 10	889 +/- 10	1225 +/- 15	1442 +/- 15
CONTACT GAUGE WHIT A 0.3 Kg CHARGE μm (r.m.s.)	276 +/- 10	212 +/- 10	214 +/- 10	245 +/- 10	489 +/- 10	798 +/- 10	1005 +/- 10	1202 +/- 10

CONCLUSION

Several improvements in the experimental setup have been studied trying to overcome major system's limitations [2] and especially looking at the particular requirements of fabric samples: large depth of focus, high lateral resolution, high vertical resolution in thickness measures from tens microns to some milimeters, nonhomogeneous samples, etc.

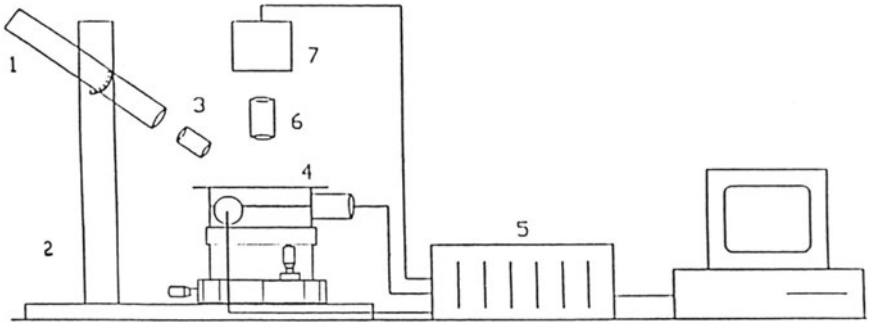

Fig. 2. Experimental setup: 1) HeNe laser, 2) Laser supporting structure, 3) Incidence optical system, 4) Sample positioning setup, 5) System's control unit, 6) Reception optical system, 7) CCD camera.

REFERENCES

1. Manuel F. M. Costa and J. B. Almeida, "Surface Relief Mapping", SPIE, Vol. 1010 (88).

2. Manuel F. M. Costa and J. B. Almeida, "An Optical Non Contact Microtopography System", to be published.

3. Manuel F. M. Costa and J. B. Almeida, "Surface Microtopography of Thin Silver Films", SPIE, Vol. 1332 (1990).